



## HAUGHTON-MARS PROJECT 2000

July 2000

NASA's Johnson Space Center will be participating in a collaborative exercise with NASA Ames Research Center and the Haughton-Mars Project 2000 field deployment to Devon Island, Canada, this summer.

The JSC team will use scientific and research personnel and activities at Devon Island to simulate operations on a distant world, and staff a mission operations support center in Houston.

The purpose of the Haughton-Mars Project 2000 simulation is to demonstrate various operations technologies and functions that can be applied to human expedition missions. Current mission operations philosophy and procedures are designed to support missions of limited duration in near-Earth environments. Supporting humans on expeditions to explore distant worlds will bring rise to new challenges related to distance and duration. These challenges include:

- Coping with communications delays;
- Interacting with science teams;
- Planning and tracking crew activities;
- Planning and tracking the use of consumables;
- Forecasting and tracking weather conditions, and
- Validating technologies and operations for medical support.

Some of the experience from this exercise also may help provide improved understanding of medical logistics requirements for the International Space Station.

### Support Teams

Two JSC organizations, the Mission Operations Directorate (which is responsible for space shuttle and International Space Station operations) and the Space and Life Sciences Directorate (which is responsible for supporting all shuttle and station medical activities) will form an integrated team supporting the activities at Haughton Crater. The Space and Life Sciences portion of the team will participate July 1-26, 2000. The Mission Operations' Human Exploration Operations Team will conduct simulations July 5-21, 2000.

A total of 19 JSC team members will participate in this year's exercise. Four will travel to Devon Island and participate in on-site activities, while another 15 team

members will support from an Exploration Planning Operations Center (ExPOC) at the Mission Control Center in Houston.

### **Mission Operations**

The Human Exploration Operations Team will focus on simulating operations research for human expeditions. The leader of this team, Anthony Griffith, will travel to Devon Island. The operations manager, Catherine Koerner, will lead support activities from the ExPOC in Houston.

The primary objectives of the simulation will be to test ways to effectively deal with:

#### Non-synchronous Communications

Communication will be conducted in a "store and forward mode," which is being evaluated for future expeditions which, by their nature, may not accommodate real-time communications and/or may require communication delays.

Communication between the operations center and the expedition site will include daily downlinks of data files, digital still images, voice and video files. Also, the daily evening planning session, conducted at Haughton Crater, will be routinely monitored.

#### Science Team Interaction

Extensive science team interaction, between researchers at Devon Island and various principle investigators, will be coordinated through the operations team at JSC. This interaction is necessitated by an exercise to evaluate dual planning concepts. In these concepts, the ground provides activity planning guidelines and a prioritized daily task list while the expedition crew is responsible for real-time execution planning.

#### Tracking and Planning

The operations team also will provide support through a variety of tracking and planning functions for the expedition team. This includes Global Positioning System plotting and logging of expedition traverses, logging of electronic field notes and data using Personal Data Assistant (palm-sized computer, or PDA) technology, and maintenance support for selected equipment such as all-terrain vehicles, communications systems and electrical power systems.

#### Supply Management

Consumables tracking will be performed for items such as gas (ground and aircraft vehicles), oil, food and general medical supplies. As needed, re-supply recommendations will be provided to re-supply channels from Resolute, Canada.

Weather Forecasting

JSC operations support also includes 24 and 48 hour local Devon weather forecasting, space weather, ozone and UV flux reporting, as well as analysis of recorded weather data.

**Operations Team**

The Human Exploration Operations Team will be made up of six disciplines, each responsible for a particular area of support related to leadership, communications and activity planning, data analysis, science operations, weather forecasting and medical operations:

Operations Director (OPS Dir)

- Responsible for leading the team and ensuring all milestones are satisfied
- Primary responsibility for preparing the daily uplink package
- Responsible for safety topics and metrics
- Coordinates with Weather Data Analysts and Medical Operations Officer

Communications and Activities Officer (CAO)

- Responsible for ensuring the transmission of all audio, video and text data products between site and ExPOC
- Responsible for product exchange among participating external sites
- Plans, prepares and evaluates site training exercises

Data Analysis Officer (DATA)

- Responsible for tracking and plotting downlinked traverse data
- Performs consumables and logistics data monitoring and analysis
- Responsible for coordinating IFM data and procedures

Science Operations Officer (Science)

- Responsible for the coordination of science data between the exploration site and various investigators
- Responsible for ensuring that all operations criteria relating to the science activities are met

Weather Data Analyst (WDA)

- Responsible for the analysis and forecasting of weather at the exploration site
- Participates as an adjunct support position in the ExPOC
- Supported by a representative NOAA Spaceflight Meteorology Group from JSC weather office

Medical Operations Officer (Med OPS)

- Responsible for interfacing with the site team and JSC Med Ops community on all site personnel medical issues
- Interacts with ExPOC personnel on non-personal medical topics related to safety, metrics and consumables tracking

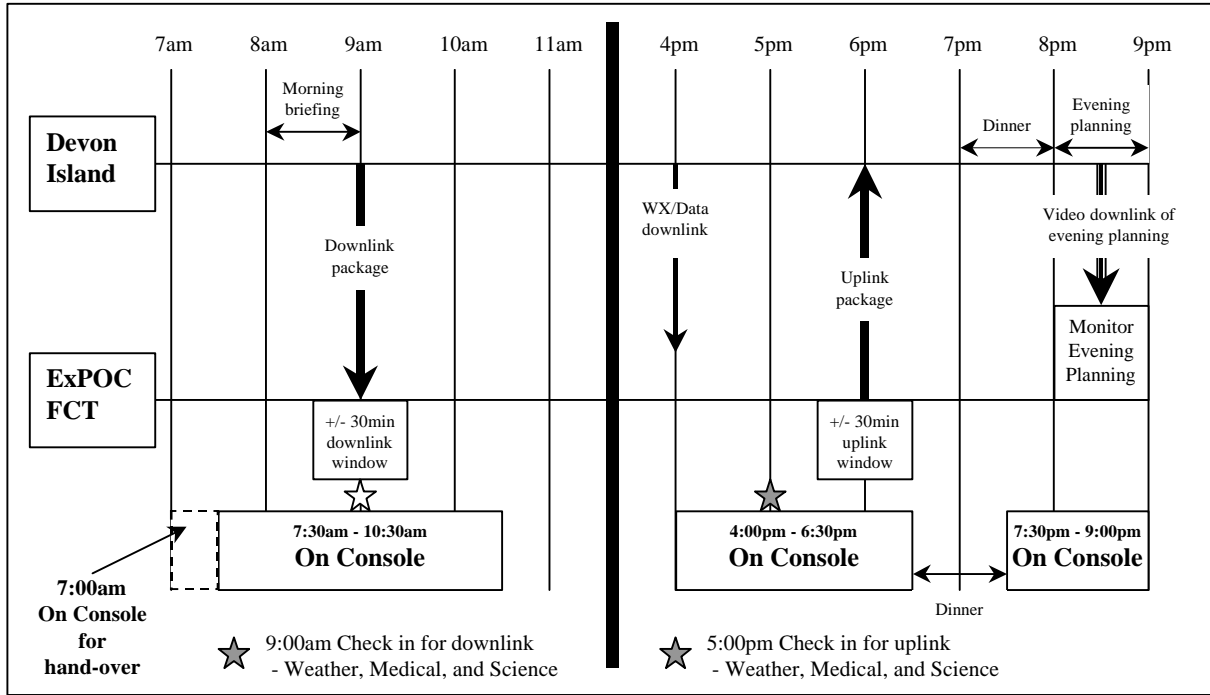
The Houston team also includes support from three Kennedy Space Center members of the Human Exploration Operations Team, who will staff the Science Operations Officer position.

Key personnel supporting the simulation and the dates they will be supporting:

<b>Dates</b>	<b>Expeditioners at Haughton Crater</b>
July 5-21	Anthony Griffith
July 1-12	Dr. Jeffrey Jones
July 1-14	Terry Guess
July 12-26	Dr. Rainer Effenhauser
July 12-26	Douglas Butler
<b>Dates</b>	<b>Operations Director in Houston</b>
July 5-7	Jean Wall
July 10-12	Doug Rask
July 13-14 & 17-18	Bill Powers
July 19-21	Catherine Koerner

### Daily Support Plan

The following is a graphic representation of the Daily Support Plan that will be followed by the Human Exploration Operations Team:



### Medical Operations

JSC's Space and Life Sciences Directorate will participate in the Haughton Mars Project in an effort to validate proposed technologies and operations concepts for exploration-class medical operations. Over the period of July 1-26, 2000 engineers from Wyle Laboratories' Advanced Projects Section and NASA Flight Surgeons will:

- Conduct activities in a completely "store-and-forward" manner, using a 40-minute round-trip latency to simulate planetary exploration;
- Develop and validate operations concepts, procedures and protocols consistent with store-and-forward support;
- Validate relevant technologies and systems in an operational environment;
- Collaborate with extramural organizations to develop and validate mutually beneficial systems, procedures, protocols, and operations concepts;
- Work in conjunction with other participating NASA organizations to develop and validate exploration-class systems and operations;
- Develop and validate requirements and systems for Earth-based medical support of exploration missions using the ExPOC, using commercial off-the-shelf technologies and state of the art communications such as satellite links and wireless local area networks;

The Medical Operations team will address three areas of interest associated with the clinical capabilities needed to deal with illness, ambulatory health problems, trauma and acute medical problems to support expeditions by humans to distant worlds. These technology evaluation and procedure development activities will involve human subjects in order to gather physiological and clinical test data to permit evaluation of the medical technology and communications infrastructure.

The three areas of interest are:

#### Evaluation of Store-and-Forward Telemedicine

Low-Earth orbit medical operations rely on extensive real-time and near-real-time communications with Earth-based medical personnel, as satellite communications are available and latency is typically less than 2 seconds. However, planetary exploration missions will be characterized by delays of 7 to 40 minutes. Therefore, remote support from Earth must be conducted in a store-and-forward manner. This investigation will examine several technical and clinical aspects of store-and-forward telemedicine.

#### Medical Logistics Management

All materials and supplies required for medical care during the Haughton Mars Project 2000 expedition will be tracked to assist in medical logistics requirements for the International Space Station and exploration class missions.

#### Assessment of Medical System Requirements for Planetary Exploration

The team will attempt to characterize the incidence of medical events in this environment, assess medical information and wireless telemetry technologies, and collect photo/video documentation of expedition medical facilities.

### **Telemedicine Technology**

Telemedicine will be supported by a communications infrastructure utilizing the ANIC E-1, geosynchronous Telesat and the Canadian Communications Research Center ground relay station support in Ottawa providing an estimated bandwidth of 128 kbs/sec. Specific systems evaluated during these investigations include:

#### Telemedicine Instrumentation Pack (TIP)

This is akin to a portable "multimedia doctors bag" equipped to digitally collect images of the eye, ear, nose, mouth, throat, and skin, sounds from an electronic stethoscope, and biomedical data from electrocardiogram, blood pressure, and pulse oximetry. The data is stored in an electronic medical record that can be transferred to a consultant for review. This system has been tested aboard the space shuttle and in rural Montana for telemedicine applications.

Commercial Off-the-Shelf Hardened Laptop Computer

Designed for operation in harsh environments, this computer will serve as the base for several medical instruments, data acquisition, network connectivity, and report writing.

Commercial Off-the-Shelf Portable Ultrasound System

A portable ultrasound system weighing only 5.4 pounds will be used as a non-invasive diagnostic tool. The battery-powered and fully self-contained instrument is approved for clinical use and is undergoing evaluation for its utility for ultrasonic imaging in microgravity. The JSC Medical Operations team will collaborate with clinical experts from the Cleveland Clinic Foundation.

Digital camera

This will enable the acquisition of dermatology images and other superficial images for store and forward transmission. The JSC Medical Operations team is working with the Walter Reed Army Medical Center's Teledermatology Program.

Personal Information Carrier

The Personal Information Carrier is an "electronic dog tag" ruggedized flash memory card developed by the U.S. Army Medical Research and Materiel Command Telemedicine and Advanced Technology Research Center so that personnel may have an electronic medical record with them at all times.

Electronic Medical Record Management

Several medical record packages will be evaluated for their suitability to the medical context of an exploration class mission and "store and forward" telemedical consultation.

Sortie Medical Awareness Technology

A wearable computer system, coupled with a vital signs monitor and biomedical sensors, will be used to collect limited data that will be transmitted via local communications from remote field operations to the base camp. A Remote Deployable Telemedicine Unit will be used to connect to a web-based electronic medical record collaboration tool. The JSC Medical team is working with the NASA/Virginia Commonwealth University Medical Informatics and Technology Applications Consortium.

**Key Personnel Biographies**Douglas J. Butler

Butler received his B.S. in Mechanical Engineering from Virginia Tech in 1987 and possesses 13 years experience in systems analysis and integration, medical device design and testing, and medical logistics. Since November of 1992, Butler has worked for Wyle Life Sciences' Medical Operations Group at

Johnson Space Center in Houston. Butler was the Lead Project Engineer responsible for the development and space-flight certification of the operational medical systems currently manifested aboard the International Space Station. Since January of 1997, Butler has managed NASA Medical Operations' effort to identify and validate state-of-the-art technologies that may increase the standard of health care during low earth orbit and exploration-class space missions. He is an investigator and an expeditioner in HMP 2000.

Dr. Rainer K. Effenhauser, MD

Effenhauser is a Flight Surgeon at JSC in Houston. He serves as a physician in the Flight Medicine Clinic, and is lead of the Space Shuttle Mission Support Section in the Medical Operations Branch. Effenhauser has been a flight surgeon at NASA/JSC since 1994, and has supported more than 30 space shuttle flights (including 12 as crew surgeon or deputy crew surgeon). Effenhauser earned a B.S. degree in Molecular Biology in 1985, and received his M.D. from the University of Wisconsin-Madison in 1989. Following a transitional year internship, Effenhauser completed his residency at Wright State University in 1992, and received a M.S. degree in Aerospace Medicine. He has previously served as a primary care physician for military dependents at Wright-Patterson Air Force Base in Dayton Ohio, and as a Medical Operations Physician involved with space station medical hardware development at Krug Life Sciences in Houston Texas. As a NASA Flight Surgeon, he has supported the medical clinic in Star City, Moscow and water survival training for several international space station crews at the Black Sea, Russia. He is an investigator and an expeditioner in HMP 2000.

Anthony D. Griffith Sr.

Griffith serves as the Lead of the Human Exploration Operations Team, responsible for integrating NASA intercenter operations support into research activities for human missions beyond low earth orbit. A former flight controller in the Flight Activity Officer (FAO) position, Griffith supported more than 15 space shuttle missions from the Mission Control Center. Following a B.S. in Mechanical Engineering from Texas A&M University, Mr. Griffith received his M.S. in Physical Science – Space Science from the University of Houston-Clear Lake in 1991. Currently serving as the Technical Assistant for Strategic Operations Planning in the Mission Operations Directorate, Griffith has focused on operations technology development and advanced planning since 1994. He has managed software development tasks spanning both ground and flight systems for both the Space Shuttle and International Space Station Programs. He is an investigator and expeditioner in HMP 2000.

Dr. Jeffrey A. Jones, MD

Jones is a NASA Flight Surgeon and the acting Operational Radiation Biologist. He is also an adjunct Associate Professor at the Baylor College of Medicine and is board-certified in Urology and Preventive Medicine – Aerospace. Jones



received his medical degree from the Baylor College of Medicine in 1984 and his M.S. in Preventive Medicine & Community Health from the University of Texas Medical Branch in 1998. His duties as a Flight Surgeon with the NASA/JSC Medical Operations Branch include the Multilateral Medical Operations Panel Radiation Health and Countermeasures and Monitoring (co-chair) Working Groups; the Bone and Muscle Exercise, Radiation and Nutrition Integrated Product Teams; and the Diet and Urinary Countermeasures Working Group. He is also an International Space Station Flight Surgeon. Jones participated in HMP 99 as both an investigator and expedition team member, and he is a principal investigator and an expeditioner in HMP 2000.

Catherine A. Koerner

Catherine A. Koerner earned her B.S. and M.S. degrees in Aeronautical and Astronautical Engineering from the University of Illinois (Urbana-Champaign). She is currently serving as the Lead of the Propulsion Systems Group, Mission Operations Directorate, where she leads a group of shuttle flight controllers. Koerner has been with JSC since 1991 during which time she has supported more than 40 shuttle missions as a certified flight controller. Prior to coming to work at JSC, Koerner worked at NASA's Jet Propulsion Laboratory in Pasadena, CA, participating in mission design studies for various advanced projects and conducting research in robotic pre-cursors to human exploration missions.

Dr. Patrick J. McGinnis, MD

McGinnis has been a NASA Flight Surgeon since 1994. He also is an Air National Guard Flight Surgeon. He received his medical degree from the University of Kentucky College of Medicine; trained in Aerospace Medicine at Wright State University and Internal Medicine at the University of Texas Medical Branch. He is currently pursuing a degree in Health Informatics at the University of Texas-Houston Health Science Center. McGinnis served as the Crew Surgeon for the Mir/NASA-3, Mir/NASA-7 missions and as Deputy Crew Surgeon for STS-84. He is currently assigned as Crew Surgeon to the ISS-2 mission. McGinnis participated in the Devon Island/HMP in 1999 as both an investigator and expedition team member, and he is a principal investigator in HMP 2000.

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